Traumatic Brain Injury

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Patient history

19-year-old male, severe head trauma after a motorcycle accident occurred 2 days before. Brain computerized tomography scans (CT) revealed a hemorrhagic lesion in the brainstem. Damage from traumatic brain injury can be focal or diffuse. Diffuse trauma to the brain is frequently associated with concussion, diffuse axonal injury (ref.1). An MRI is performed for prognostic evaluation, to assess for critical brainstem and cortico-spinal track damage. Brain MR imaging remains to be the modality of choice for the recognition of brainstem hemorrhage in patients with traumatic head injury (ref. 1).

Morphological findings

Fluid-attenuated inversion recovery (FLAIR) MR images, reconstructed in the axial and sagittal planes (Figure 1), showed a cerebral hemorrhagic contusion in the pons what is common in the setting of significant head injury. The cerebral hemorrhagic contusion was detected close to the left corticospinal that serves as the main conduit of information between the higher cortical structures and the voluntary musculature, and spinothalamic tracks, one of the most important sensory pathways of the nervous system. "Mirror" left internal hemorrhagic concussion was clearly seen on the imaging.

Post-processing and analysis

DTI acquisition was processed using the Olea Sphere® Software. Three visualization techniques were used:

- Global display of the white matter tracks: there is no significant alteration of the white matter tracks in the brainstem and corpus callosum (Figure 2A).
- Tracking of the left corticospinal track performed by positioning one seed in the pons, another seed close to the left motor cortex and one more "negative" seed in the right corticospinal track to remove the aberrant tracks caused by the decussation. The corticospinal track looks perfectly preserved (Figure 2B).
- The measurement of Fractional anisotropy (FA) that is proportional to the density of fibers. The major decrease of FA value suggests severe damage of the white matter. In this clinical case the FA map was superimposed on the FLAIR (fluid attenuated inversion recovery) imaging and showed no significant alteration of the FA on the corticospinal and spinothalamic tracks (Figure 2C).

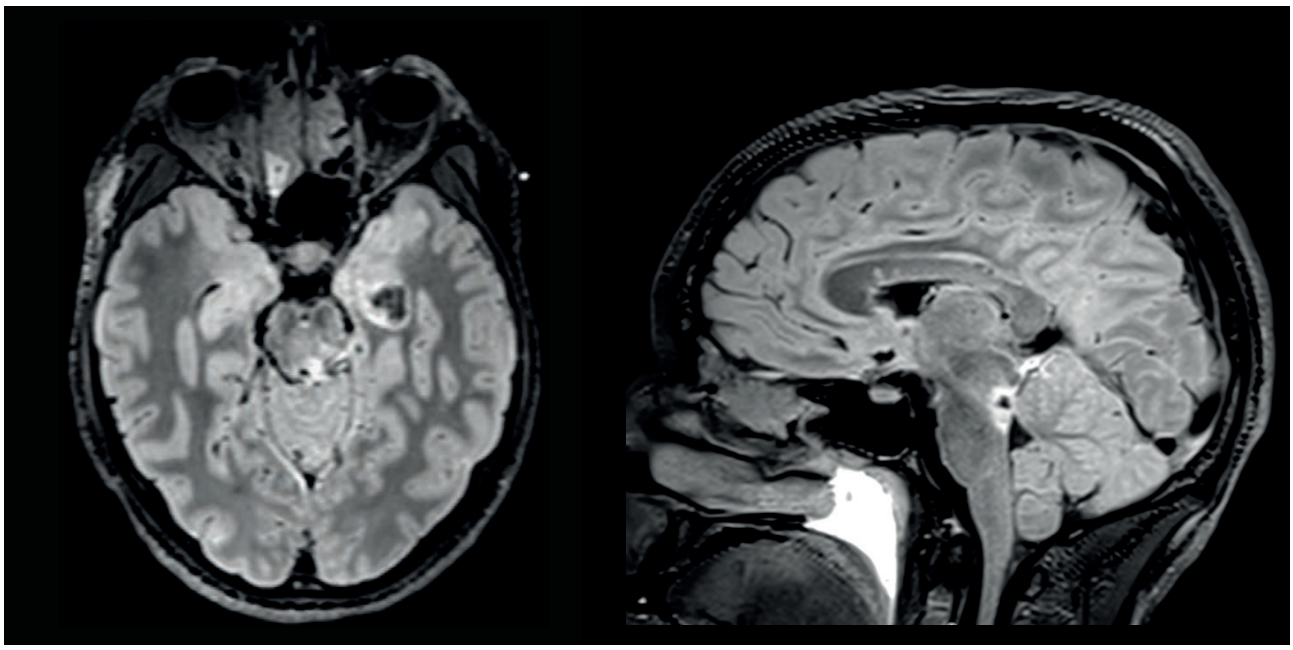

Figure 1 FLAIR acquisition, reconstructed in the axial and sagittal planes

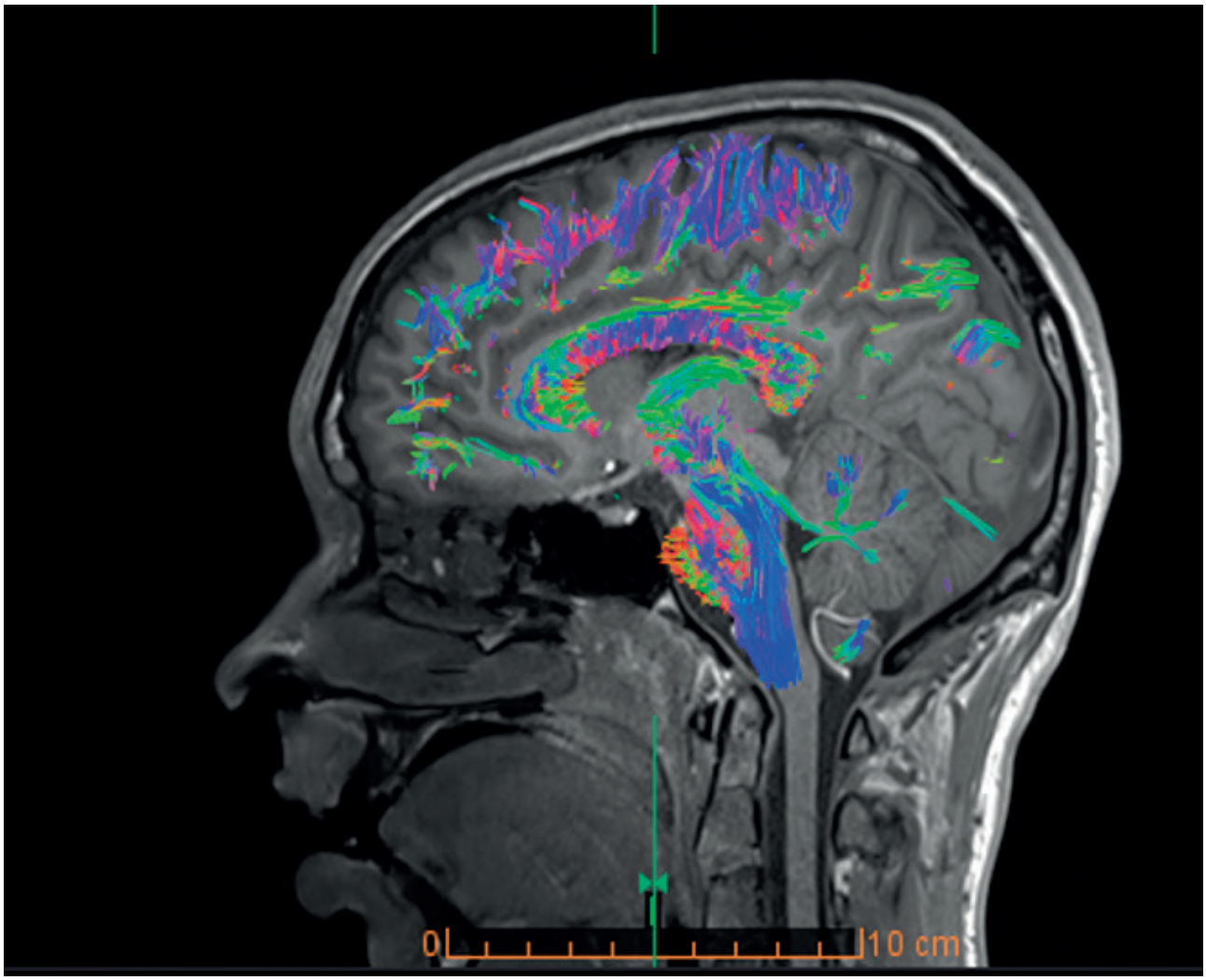

Figure 2A

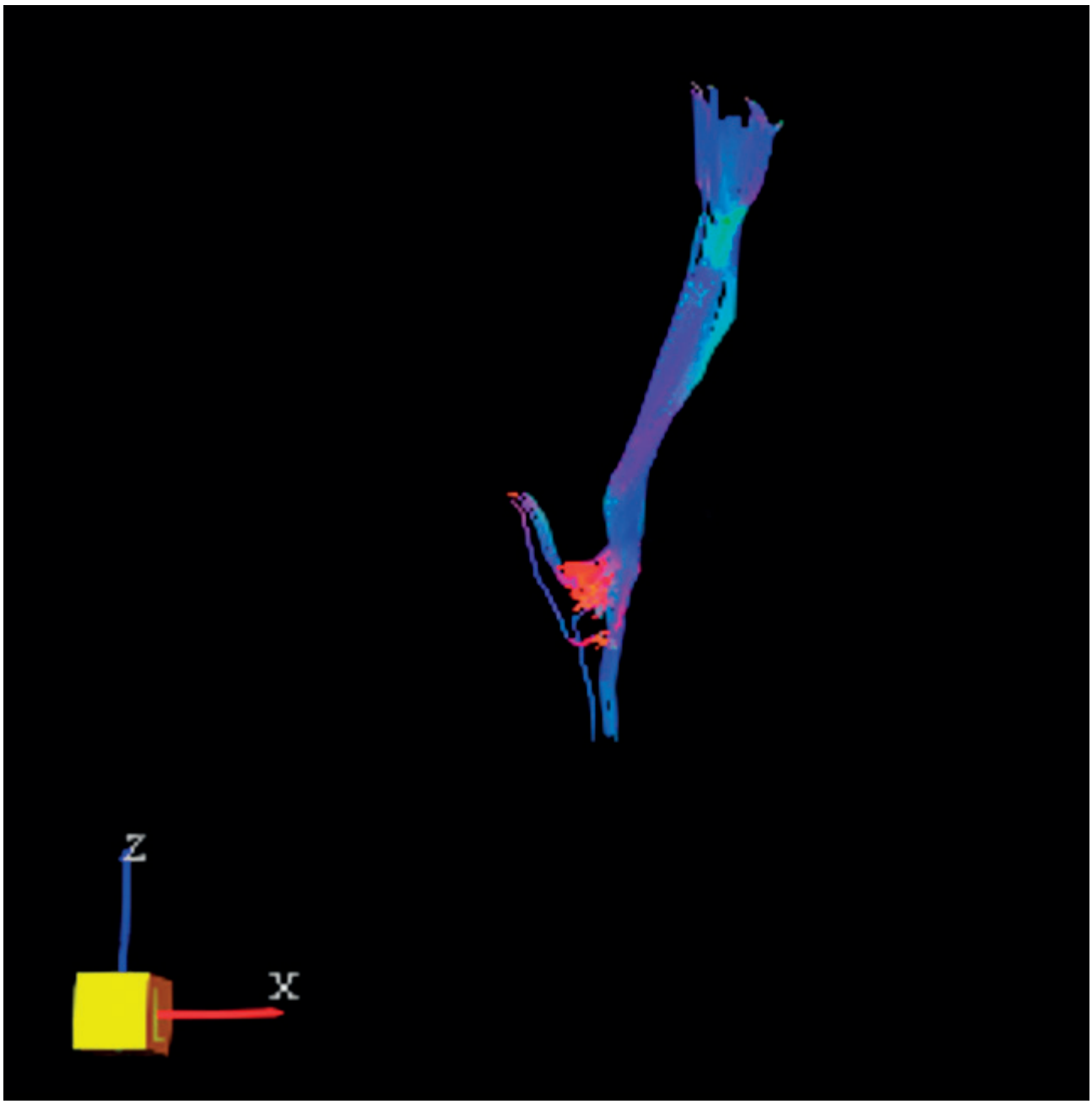

Figure 2B

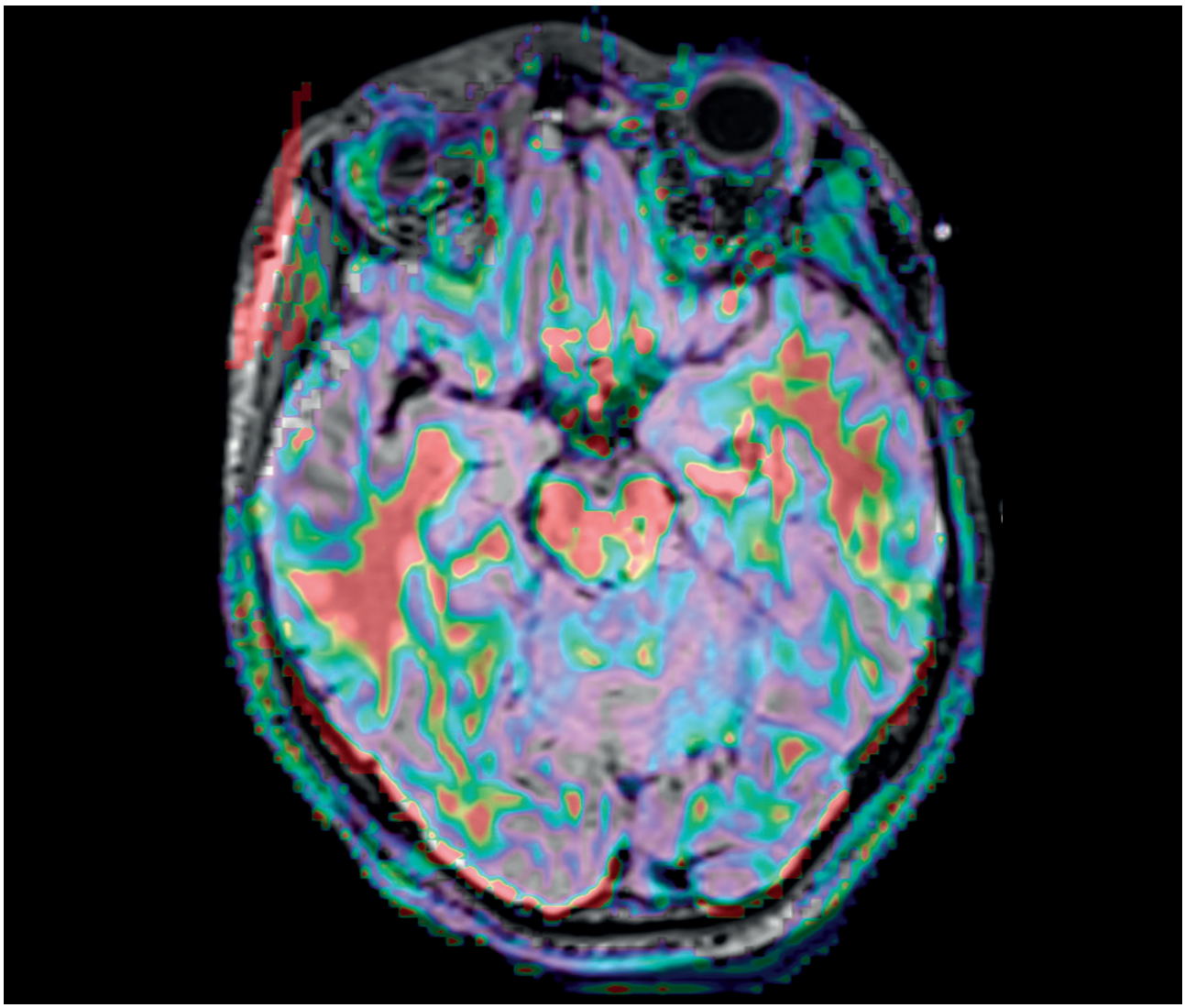

Figure 2C

Conclusion

Patient recovered consciousness within a few days. He was discharged from neuro ICU after one month, with no residual motor deficit. He is currently in rehabilitation.

Neuroimaging plays a critical role in the setting in traumatic brain injury. Conventional MRI is unable to visualize many of white matter tracts. DTI allows for visualization of these white matter tracts by imaging the anisotropy of water diffusion (ref. 2).

References

1. Traumatic Brainstem Hemorrhage Presenting with Hemiparesis. Young Bem Se, M.D., Choong Hyun Kim, M.D., Koang Hum Bak, M.D., and Jae Min Kim, M.D.

2. Diffusion Tensor Imaging of TBI: Potentials and Challenges. David B. Douglas, MD, Michael Iv, MD, Pamela K. Douglas, PhD,† Anderson Ariana, PhD, Sjoerd B. Vos, PhD, Roland Bammer, PhD, Michael Zeineh, PhD, MD, and Max Wintermark, MD

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